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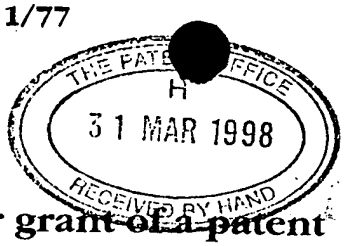

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1/77

01APR98 E350079-1 D02829
P01/7700 25.00 - 9806945.3

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
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1. Your reference

J00040582 GB

2. Patent application number
(The Patent Office will fill in this part)

31 MAR 1998

9806945.3

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

BRITISH TELECOMMUNICATIONS public limited company
81 Newgate Street
London
EC1A 7AJ

Patents ADP number *(if you know it)*

6300388001

If the applicant is a corporate body, give the country/state of its incorporation

United Kingdom

4. Title of the invention

SIGNALLING

5. Name of your agent *(if you have one)*

R.G.C. Jenkins & Co.

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

26 Caxton Street
London SW1H 0RJ

Patents ADP number *(if you know it)*

950001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

YES

SIGNALLING

This invention relates to methods and apparatus for signalling between a first terminal and a second, via a network employing a signalling protocol.

One such access signalling protocol is defined in ITU Q2931, entitled "Broadband Integrated Services Digital Network (B-ISDN) - Digital Subscriber Signalling System No 2 (DSS 2) - User-Network Interface (UNI) Layer 3 Specification for Basic Call/Connection Control", well known, and available from the International Telecommunications Union, of Geneva, Switzerland.

This protocol defines the signalling procedures to be followed by a first terminal in accessing a second to set up and operate an ISDN communications session.

Many conditions may exist or occur during such a communications session. For example, the remote terminal may be busy, or unable to signal at a certain rate, or unobtainable (damaged or switched off). Alternatively, the network may be congested, or a busy tone may be generated from the local exchange. Data may be lost, or delayed, or corrupted in passage.

Many such protocols, such as Q2931, define a state machine; that is to say, a machine that can exist only in one of a number of predefined states, and can move from state to state in response to the occurrence of a predetermined event or combination of events. Actions are performed in moving the terminal from one state to another.

Such events may be, for example, the receipt of a defined signal from the second terminal via the network, or the elapsing of a predetermined time in the state. The actions taken in response may involve external signalling, or resetting an internal timer, and moving to a new state. The protocol defines the set of states, and the set of actions, and the events triggering the performance of the actions and changes of state.

Accordingly, the present invention provides a system in which a terminal only stores code to execute this core behaviour. The remainder of the responses, for handling unusual events, are stored elsewhere at a store in the network (for example at a Network Server computer forming a node of the network). On encountering an exceptional event, the terminal receives data from the store to enable it to handle the event.

The terminal may signal to the store to request such data on encountering an exceptional event. The signal may indicate the event, and the state of the terminal on encountering it.

In one embodiment, the data comprises code which the terminal can store and execute as an additional action, for use in future communications sessions. Thus, the core of actions stored at the terminal can be augmented by the addition of those extra actions needed to deal with only those exceptional events which have occurred in the past (and may be likely to recur). The storage may be long-term, or the terminal may discard little-used stored extra actions.

In another embodiment, the data comprises instructions executed by the terminal to handle the exceptional event, but not stored for future use. Thus, local storage requirements are minimised.

The store and/or the terminals may initially determine whether the stored core behaviour is current, and if not, current actions may be downloaded from the store to the terminals for future use.

Other aspects, embodiments and preferred features of the invention will be apparent from the following description and claims, together with the advantages thereof.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

First embodiment

Referring to Figure 1, the present embodiment comprises a first terminal 10, a second terminal 20, and a telecommunications network 30 including a network node 40.

The term "terminal" herein indicates that the terminals are external to the network (i.e. are at network terminations) rather than implying any particular structural or functional limitations.

The first terminal 10 comprises a Network Computer. Referring to Figure 2, it consists of a control circuit 11 (e.g. a microprocessor or microcomputer such as a Pentium 2 processor available from Intel, or a StrongARM reduced instruction set computer (RISC) available from Acorn Ltd).

Coupled to the control circuit 11 (e.g. via buses) are an instruction store 12 (comprising, for example, a ROM or an EPROM or a Flash programmable memory) holding the operating system, applications programs and communications programs for the terminal 10, and a read/write working memory 13 (e.g. a RAM) for retaining data and transitory programs.

The operating system may comprise Windows 95 (TM) or Windows CE (TM) and is arranged to accept a downloaded executable program subroutine, store it in the working memory 13, and execute it.

Further provided is a communications port 14, comprising a physical connector for connection to an ISDN line 31 connected to the network 30, and a pair of logical ports 15, 16, one (15) for connection to a data channel (e.g. an ISDN B channel) and one for connection to a signalling channel (e.g. an ISDN D channel). Other elements provided may comprise user output devices such as a loudspeaker, and user input devices such as a keyboard, cursor control device (e.g. mouse) or microphone. Where the device is intended as a set-top box, for co-operation with an existing television set, it further comprises a

5.1.2.3 Where VPCI or VCI not available
5.1.4 Where requested QoS not available
5.1.4
5.1.5 Where requested service is not authorised or not available or Time-out conditions occur
5.1.8

Section 5.2 - Normal Call Behaviour except:

5.2.1 Where Time-out conditions occur
5.2.2.2.2 Where no compatible user equipment exists
5.2.3 Where value not supported by network
5.2.3.4 Where no VCI available
5.2.3.5 Where specified VPCI or VCI is not available
5.2.6 Where requested QoS cannot be provided
5.2.5.7 Where user is incompatible
5.2.5.4
5.2.7 When Time-out condition occurs

Section 5.4 - Normal Call Behaviour except:

5.4.2
5.4.3 Where Time-out condition occurs
5.4.4 Where time-out condition occurs
5.4.5

In the foregoing, it will be understood that "VCI" indicates an ATM Virtual Channel Indicator; "VPCI" indicates an ATM Virtual Path Connection Indicator, and QoS indicates Quality of Service.

The progress of a typical call will now be described with reference to Figure 4. In a step 110, the control circuit 11 performs call set up signalling. The signals are recognised by the network server 40, which creates a connection to the second terminal 20. If, in a step 112, an exceptional event is detected (for example, a Time out, or an "error" or "busy" signal) due, for example, to network damage or congestion, the processor 11 signals to the network server 40 in step 124 as will be described in greater detail below.

When the call set up is completed (step 114), the call session takes place (step 116). After completion of the call session, call clear down

The terminal 10 receives the response message 250 in a step 128 of Figure 5a, and in step 130 the control circuit 11 executes the contents of the response message, by performing the listed tasks in field 252, outputting any message in the field 254 via the signalling port 16, and then entering the next state identified in the field 256.

In this embodiment, therefore, the control program stored within the program store 12 includes routines for interpreting the tasks downloaded within the task list field, and causing the control unit 11 to execute these, and for causing the control unit to put the terminal into one of the predetermined states of the Q2931 protocol, and for causing the control unit to output the contents of the output signal field downloaded from the network at the signalling port 16, effectively parsing and executing the downloaded instructions from the network server 40 in real time as if they were a stored protocol for dealing with the unknown event.

Thus, in this embodiment, there is no need for the terminal 10 to store additional information above the code defining the "core" behaviour within the code store 13, which may therefore be kept compact.

Second Embodiment

Although the exceptional events for which the terminal 10 does not store response actions are typically relatively rarely occurring in the first embodiment, nonetheless some types of such event may, if they occur once, recur later (for example because of some recurrent or persistent network congestion or damage).

Accordingly, in this embodiment, the response message from the network 31 includes data which is stored at the terminal 10 to enable the terminal 10 to recognise and handle the event concerned in future without returning to the network server 40. This embodiment may therefore improve the response speed of the terminal 10 in future, and may lead to lower signalling volumes over the network 30 if the exceptional event recurs

signalling to the network server 40 where the unknown event has been encountered previously.

Third Embodiment

Whereas, in the second embodiment, the event handling data is stored in the form of instructions to be parsed and executed by a high-level interpreter program at the terminal 10, in this embodiment, low-level executable code for implementing the action for handling the unknown event is downloaded from the network server 40, the response message 200 of Figure 6b being replaced by that 201 of Figure 8 comprising serialised code for execution.

The code may be in the form of an intermediate programming language representation, such as Java (TM) code or Pascal P-code, which can be executed by a "virtual machine" interpreter or compiler forming part of the control program stored in the control program store 12.

Alternatively, the code may be low-level machine code specific to the architecture of the control circuit processor 11, in which case the request message of Figure 6a is modified to include a field indicating the processor type of the control circuit 11, and the network server 40 is arranged either to store multiple encoded programs for executing the protocol, in the machine languages of different common processors (e.g. Intel processors, Motorola processors, Acorn processors and the like), or to store multiple compilers for generating code for each such processor from a single stored high-level representation of the protocol.

On receiving the response message of Figure 8, the control circuit 11 stores the code in the memory 13. The control program for executing the actions is therefore distributed between the original "core" action modules stored in the store 12, and the downloaded modules stored in the memory 13. Referring to Figure 9, the stored module consists generally of a logical test (step 302) of the processor state and the unknown event followed, if they

may change and on each such change, the version number is incremented. The program store 12 in this embodiment is electrically reprogrammable by the terminal 10.

On each attempt to set up a call by or to the terminal 10, the terminal 10 signals to the network server 40 a message which includes the version number of the core actions it currently stores, in step 102 of Figure 10a. In step 152 of Figure 10b, this message is received at the network server 40 and in step 154, the network server 40 transmits back a message indicating the current version number of the core actions (i.e. the version number stored in relation to the core actions stored at the network server 40 itself).

In a step 104 of Figure 10a this is received by the terminal 10 and in a step 106 the control circuit 11 compares the two version numbers. If they match, control circuit 11 resumes with the process of Figure 4 described above to execute any one of the first, second or third embodiments as already described. The same test is performed in step 156 at the network server 40.

If the version numbers do not match, then the terminal 10 and network server 40 communicate in steps 108 and 158 to transmit a current version of the actions, as executable code, from the network server 40 to be stored in the memory 12 for future use by the terminal 10. The process of Figure 4 in relation to the first, second or third embodiments described above is then performed using the newly downloaded set of core actions.

Thus, the core action set stored on each of the terminals is updated to be current prior to each communications session.

Rather than downloading an entire replacement executable core program, it would be possible to download a list of those action subroutines or modules which have changed, together with the replacement code for those modules, enabling the control circuit 11 to amend the existing control program by deletion and replacement of parts of the program, rather than completely replacing it. Alternatively, a self-executing program for

applicable to the access signalling protocols of any other communications standard such as the GSM mobile communications protocol or its equivalents in other countries, and to communications protocols other than for access and cleardown signalling.

Although in the foregoing the terminal 10 signals to the network server 40 to indicate the unknown event and terminal state, it is possible that in some networks or under some conditions, the network server may itself be able to infer these from records of the signalling which has taken place held within the network itself and may therefore be able to supply the event handling data without requiring an initiating signal from the terminal 10.

Similarly, the network server 40 may be able to infer that certain events for which there is no responsive action within the core behaviour (e.g. the likelihood of certain types of busy state) may occur based on knowledge of current network traffic conditions, or (e.g. that the terminal makes use of rare signalling procedures) from knowledge about the other terminal involved, or the nature of the session being set up

Accordingly, request signalling from the terminal 10 is not essential to the operation of the invention.

Although updating only the core behaviour is described in the above embodiments, it would equally be possible to implement the entire signalling protocol where the storage available to each terminal is large enough, and to perform the process described in relation to the fourth embodiment to update the entire protocol. Accordingly, the feature of storage of only a limited subset of the protocol is not essential to the above described fourth embodiment, and protection is or may separately be sought for the fourth embodiment independently of such a feature.

4. A method according to claim 3, in which the first terminal is arranged to delete said stored responses under predetermined conditions.

5. A method according to claim 4, in which the predetermined conditions comprise non-use of the stored responses for a predetermined period of use.

6. A method according to claim 1, in which said event-handling data comprises data defining instructions for handling the unknown event.

7. A method according to any preceding claim, wherein the protocol is for use of an ISDN communications channel.

8. A communications system comprising;

a first terminal,

a second terminal interconnectable with the first via a telecommunications network, and

a store connected to said network;

in which:

the second terminal is arranged to communicate using a communications protocol defining a set of responses to respective conditions;

the first terminal is arranged to store, and communicate using, a subset of said protocol; and

the store is arranged to cooperate with the first terminal for handling conditions requiring a response within the set but not the subset.

9. A communications terminal for use with a communications protocols defining a set of responses to respective predetermined events, comprising;

a communications port for connection to a communications channel;

a signalling port for connection to a signalling channel; and

14. A terminal according to claim 13, the terminal being arranged to signal, for each said detected event, the internal state of the terminal prior to receipt thereof via said signalling port.

15. A terminal according to claim 9, wherein said store does not comprise a movable magnetic storage medium.

16. A terminal according to claim 15, which lacks a movable magnetic storage medium.

17. A terminal according to claim 9, which comprises a network client terminal.

18. A terminal according to claim 17, which comprises a video output port for co-operation with a television set.

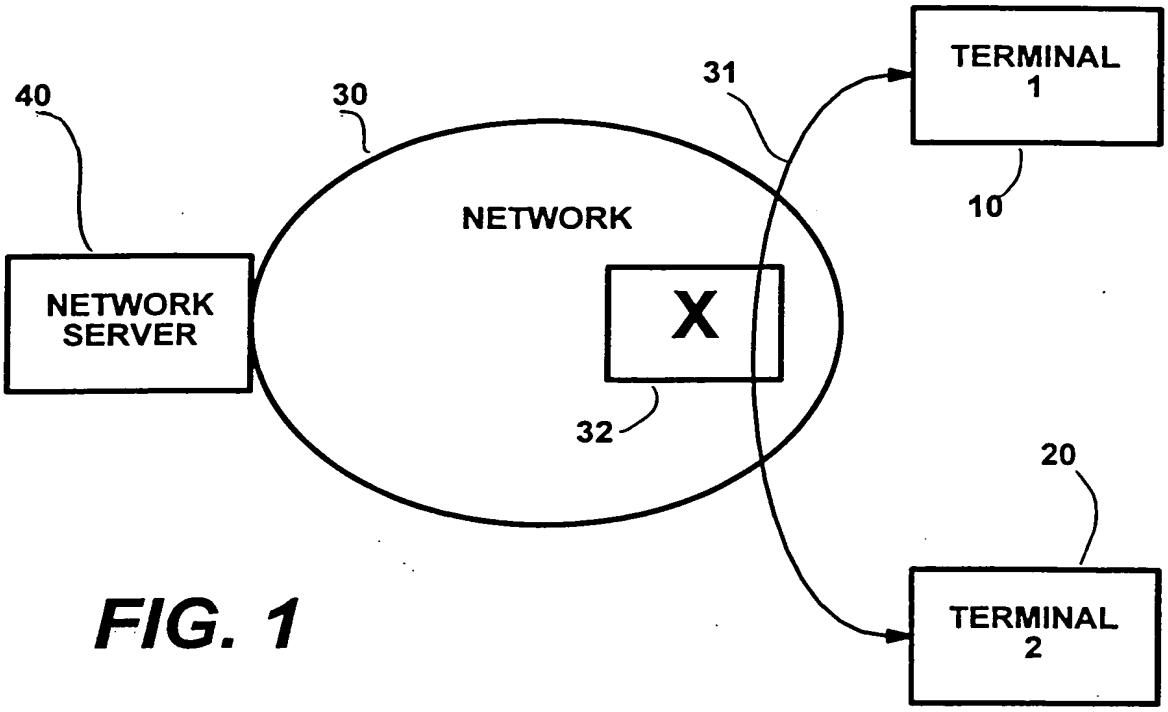
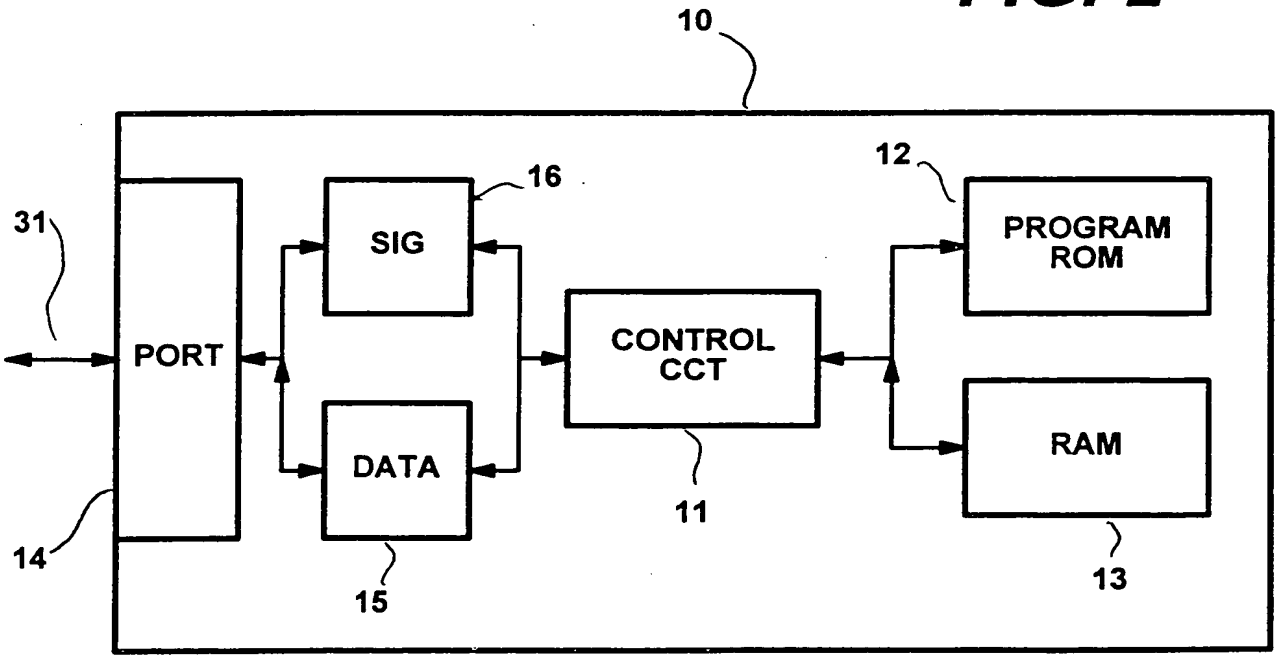

TERMINAL 1
31
40
30
10
NETWORK
NETWORK SERVER
X
32
20
TERMINAL 2

FIG. 1

FIG. 2


10
12
16
31
SIG
PROGRAM ROM
PORT
CONTROL CCT
DATA
RAM
11
14
15
13

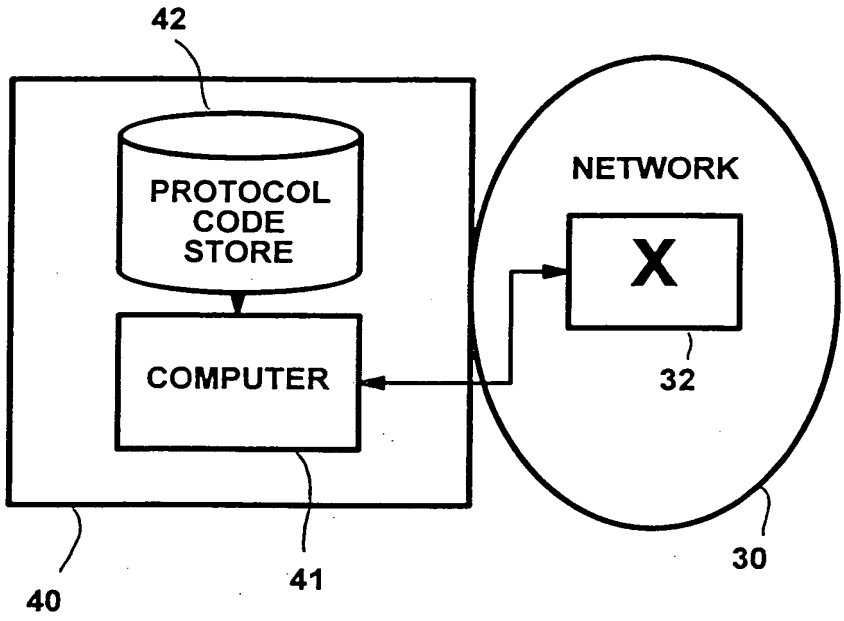


FIG. 3

Exception_Request

200

	Parameter	Parameter Description
202	Current State	Q2931 state currently in
204	Exception Trigger	Choice of Input/Time-out/Parameter. This will distinguish what has caused the exception
206	Exception Input	Required for Input trigger and probably Parameter trigger
208	Exception Time-out	Name of expired timer
210	Exception Parameter List	List of unidentified parameters

(a)

Exception_Response

250

	Parameter	Parameter Description
212	Task List	List of tasks that the access signalling process must perform e.g. parameter value assignment, decisions
214	Output	Any output message that needs to be sent
216	Next State	Q2931 state after tasks and output

(b)

FIG. 6

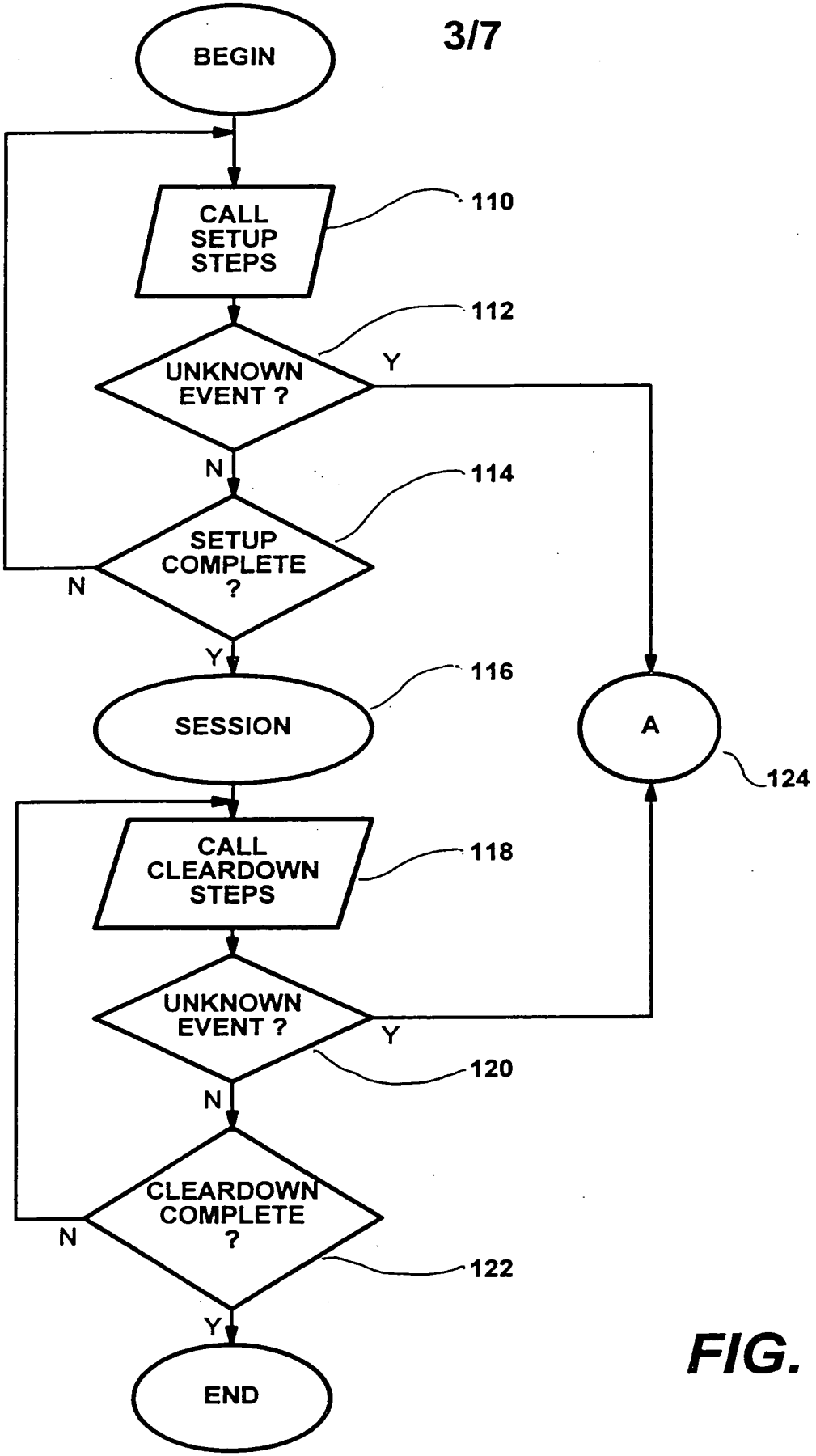

BEGIN
CALL SETUP STEPS
110
UNKNOWN EVENT ?
112
Y
N
SETUP COMPLETE ?
114
N
Y
SESSION
116
A
124
CALL CLEARDOWN STEPS
118
UNKNOWN EVENT ?
Y
120
N
CLEARDOWN COMPLETE ?
N
122
Y
END

FIG. 4

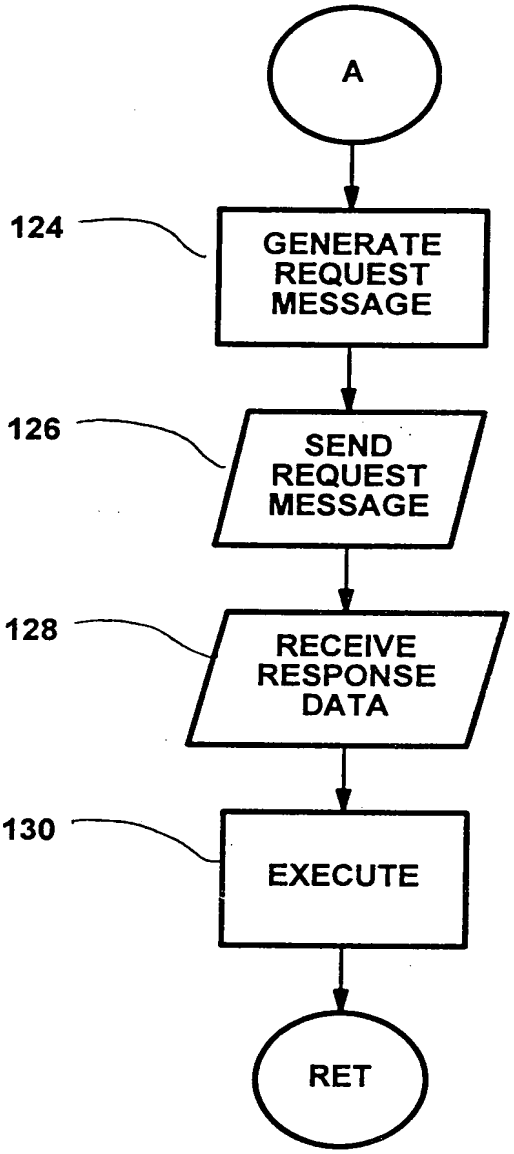

A
124
GENERATE REQUEST MESSAGE
126
SEND REQUEST MESSAGE
128
RECEIVE RESPONSE DATA
130
EXECUTE
RET

FIG. 5a

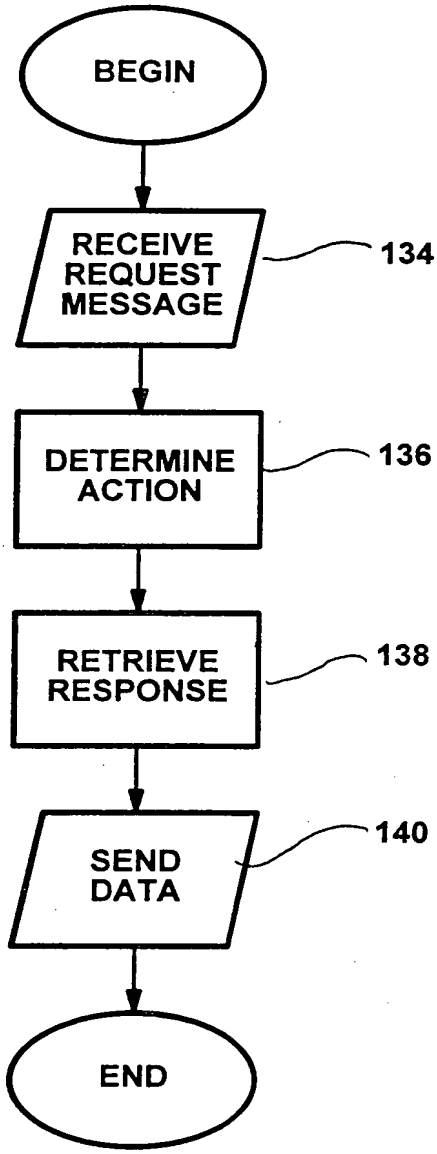

BEGIN
RECEIVE REQUEST MESSAGE
134
DETERMINE ACTION
136
RETRIEVE RESPONSE
138
SEND DATA
140
END

FIG. 5b

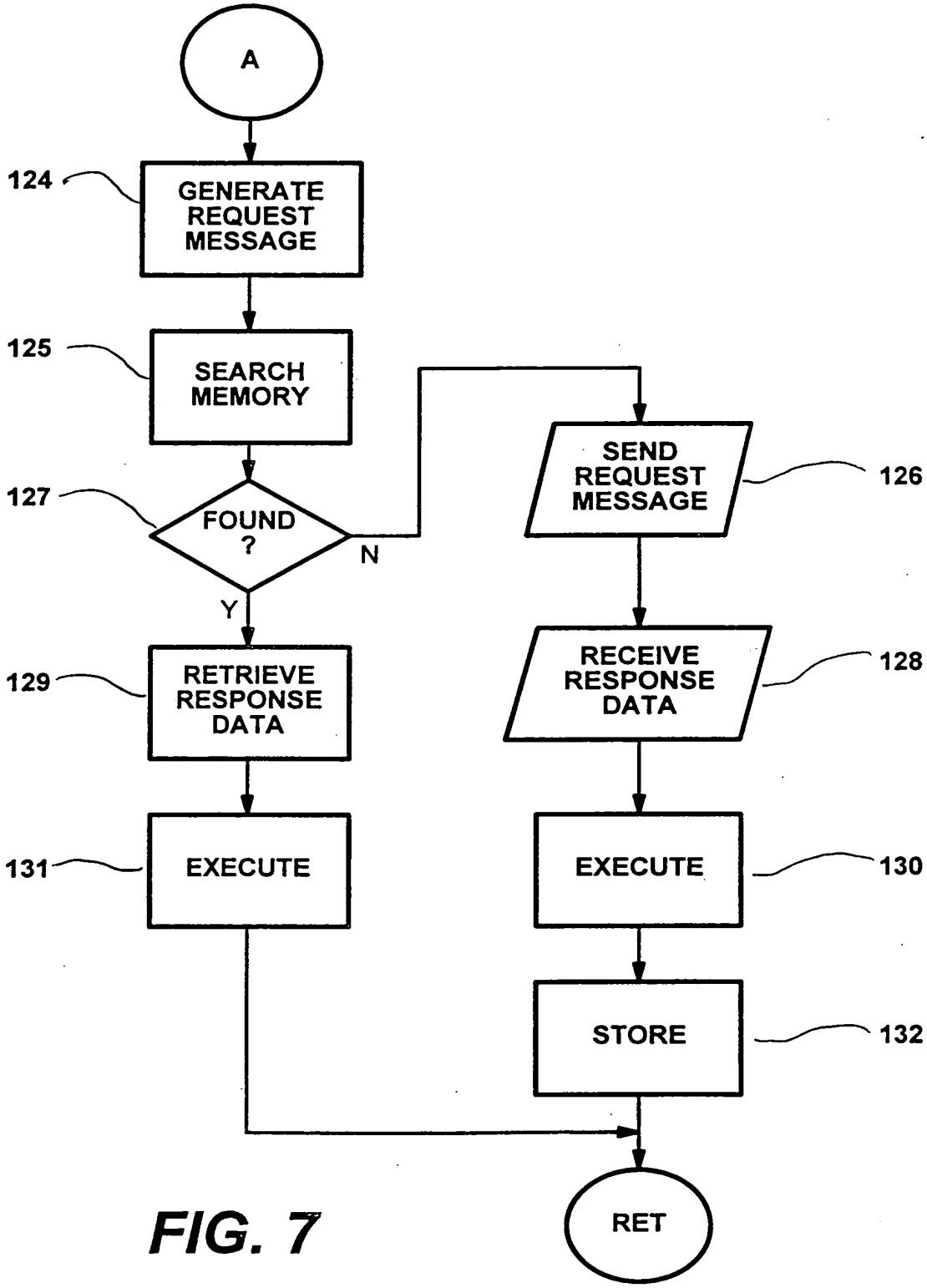

A
124
GENERATE REQUEST MESSAGE
125
SEARCH MEMORY
127
FOUND ?
N
Y
SEND REQUEST MESSAGE
126
RECEIVE RESPONSE DATA
128
129
RETRIEVE RESPONSE DATA
131
EXECUTE
EXECUTE
130
STORE
132
RET

FIG. 7

201

Exception_Response

Parameter	Parameter Description
Code	Executable code for action(s) that the access signalling process must perform

FIG. 8

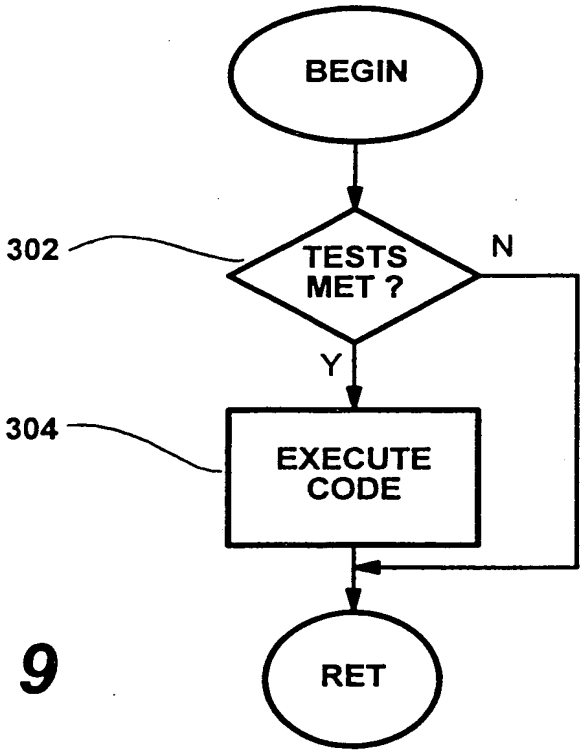


FIG. 9

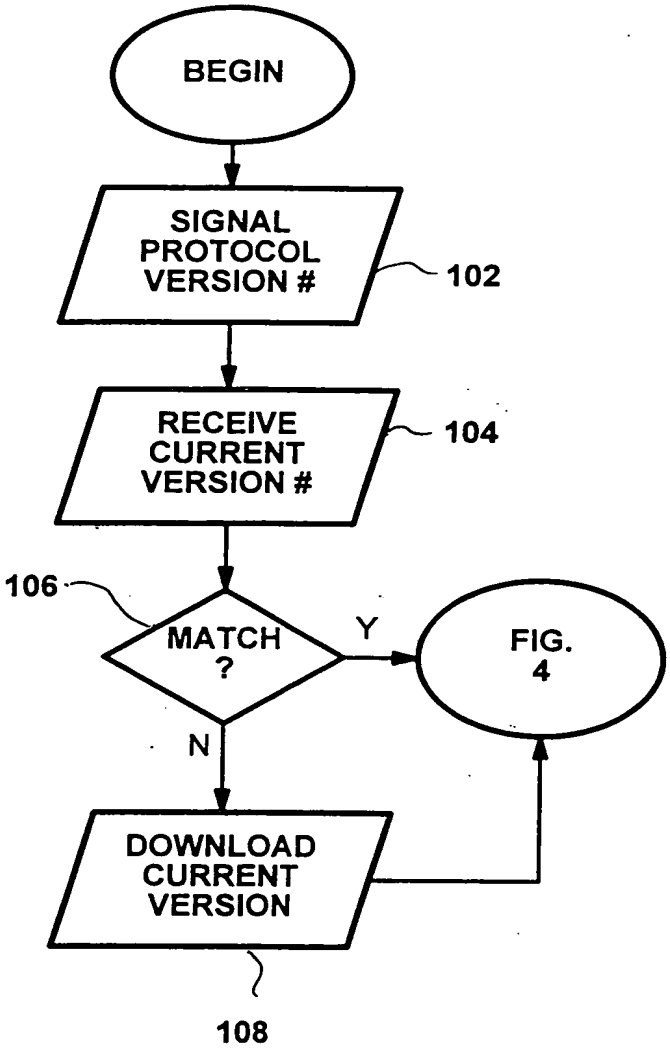


FIG. 10a

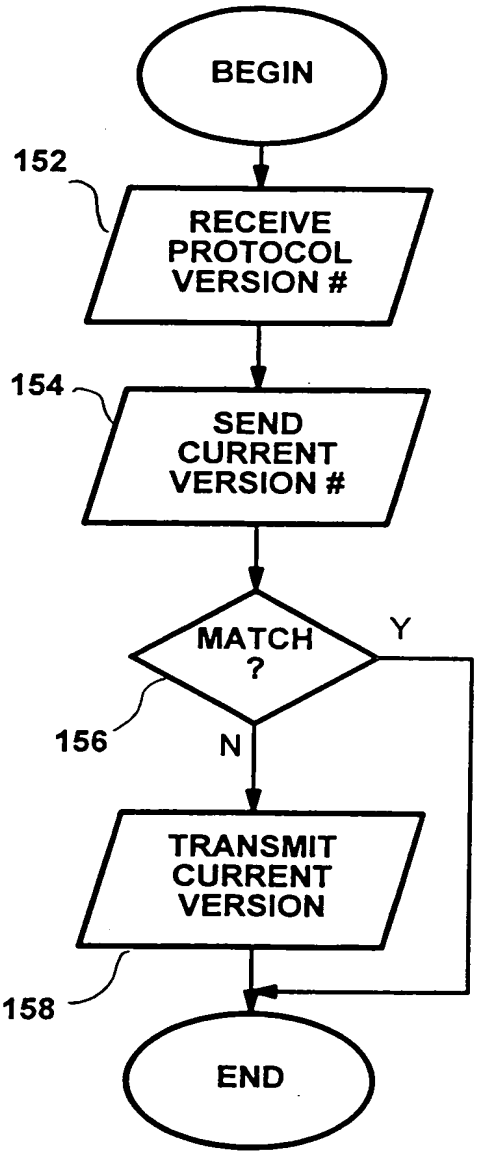


FIG. 10b

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